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Community News
Summer 2023

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Expect the unexpected

Interdisciplinary collaborations and out of the box thinking yield new ideas

Community News

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SCIENCE QUIZ

Mystery ICFOnian

Solution Ed #52

Michela Picardi

Postdoctoral Researcher,
Thermal Photonics Research Group

Science Quiz

Answers from pg 12

1:D 2:C 3:B 4:C

ON THE COVER

Expect the unexpected

In June, ICFO hosted the *Quantum Sounds Symposium*, a gathering of a growing community of artists, scientists and enthusiasts interested in exploring the interplay between music, randomness, sound, and quantum physics. Attendees had the opportunity to expand their knowledge and inspiration through some of the most recent research done on the junction of quantum physics and music composition. Invited talks, panel discussion and highly experimental music came together to create an unprecedented experience. Read more on pg 9.

EDITOR'S CORNER

ICFOnian Values

Shaping our achievements and actions

We like to think that whether explicitly stated or implicitly visible in our activities, attitudes, and achievements, the values that are part of ICFO's institutional culture shine through. Back in April we decided to reiterate a list of these values and to put them on the web to remind us all where we come from and how we aim to move forward. Taking that intention a step further, I have put some of the highlights of this edition of *ICFOnians* under the "Values" lens:

- **We believe in the potential of all people:** ICFO Outreach programs like *Be an ICFOnian for a Day* or *Quantum Carla* are looking to help young people to identify and develop their own potential for meaningful careers in our fields. They throw out a very wide net, making special efforts to ensure that groups with traditionally lower representation in STEM feel empowered to follow their dreams and skills.
- **We strive for excellence and creativity in all our work, and pragmatism and efficiency in its implementation:** Check out the overview of the *Quantum Sound Symposium* if you need proof of creativity, as well as *Latest Advances* for amazing research results that have been made possible by out of the box thinking, great attention to detail, and dedication.
- **We value collaboration and teamwork based on mutual trust, support and a positive attitude:** Every edition of *ICFOnians* is brimming with examples of achievements that would not be possible without our full emersion in the international collaborative scientific enterprise. In these pages, learn about our partnerships and leadership in research networks and European projects, collaborations with distinguished invited professors, institutional visits from members of government to prioritize strategic projects,

the PhD organized Young Atomic Opticians Conference or the IMPRS workshop, and more.

- **We value and promote diversity, equity and inclusiveness:** June is the month that the world celebrates PRIDE and ICFO's own celebration grew from all areas of the institute.
- **We aim to generate economic and social value through our activities:** KTT Director Silvia Carrasco, ICREA Prof. Valerio Pruneri and LuxQuanta CEO Vanesa Diaz accepted the *National Prize for Innovation* for the launch of ICFO's 10th spin-off, LuxQuanta, a company that is growing quickly and demonstrating strong potential to have an impact on society through IP developed at ICFO that offers an additional layer of security for the communications of public and private entities.
- **We believe that our contributions help to make a better world:** Our basic and applied research aims to develop new understanding of Nature's mysteries. We also aim to apply this understanding to technologies that will help humanity. Meanwhile, ICFOnians contribute to NGOs that aim to alleviate human suffering- and have a great time doing it. Check out the photo of participants in the 2023 Beach Volley Tournament that raised funds for the NGO *Mediterranea- Saving Humans*.

ICFO is working to offer the best possible opportunities for personal and professional development to all ICFOnians, to nourish a culture that is based on respect and positive communication, and where ICFOnians abide by a code of conduct that values honesty, integrity, and ethics.

I encourage you all, as you read on, to take stock of all that we are able to accomplish at ICFO and the important role that strong values have in the achievement of our goals.



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Happenings

ICFO NEWCOMERS

Welcome to ICFO

Many of us joined ICFO or took a new position at the institute between April and June



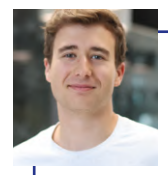
Yingjian Liu
Student



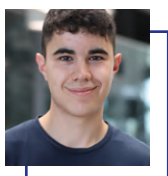
Gaëtan Peygourdi
Student



Quentin Viot
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Oriol Baldris
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Marc Molla
Student



Sergi Torres
Student



Aditya Prakash
Student



Zoé de Bigault de Granrut
Student



Elliot Holzinger
Student



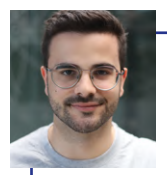
Humna Nadeem Aslam Tubassam
Student



Carolina Solé
Student



Neil Parker
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Rafael J. Fernández-Delgado
Summer Fellow



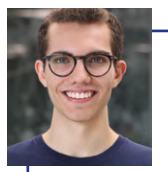
Lluís Martínez
Summer Fellow



Emilia Topp-Johnson
Summer Fellow



Laia Xiao Planas
Summer Fellow



Luis Castillo
Summer Fellow



Paula Garcia-Mochales
Summer Fellow



Monica Torrecilla
PhD Student



Mariana Navarro
PhD Student



Adélaïde Kengou
Visiting Scientist



Esteban Gerbino
Visiting Scientist



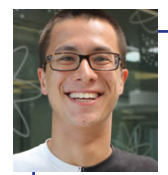
Lothaire Ulrich
Postdoctoral Researcher



Sourav Bhattacharjee
Postdoctoral Researcher



Valerio Di Giulio
Postdoctoral Researcher



Robin Camphausen
Postdoctoral Researcher



Unai Ortiz
Postdoctoral Researcher



Taewan Kim
Postdoctoral Researcher



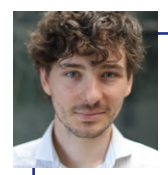
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Postdoctoral Researcher



Iris Cusini
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Julien Barrier
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Craig Chisholm
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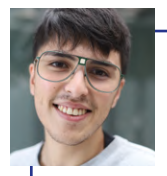
Jelena Rakonjac
Postdoctoral Researcher



Cristian García
Logistics



Daniel Castaño
Internship student



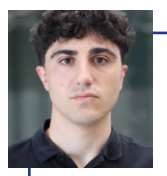
Nicolas Meza
Internship student



Francesc Xavier Galan
Finance Head



Blanca Egido
International Pre-Award Project Management



Pau Magrinyà
Pre-Award Management Staff



Cristina Morales
Pre-Award Management Coordinator

Not pictured

Luka Matic (Student), **Regina Y. Malfica** (Student), **Valeria Torres** (Student), **Sahil Pontula** (Student), **Weronika Wiesiołek** (Student), **Pau Pujol** (Student), **Guillaume Pons** (Student), **PoI Adillón** (PhD Student), **Chiara Michelini** (Visiting PhD Student), **Morteza Moradi** (Visiting PhD Student), **Narges Mohammadi Rozbahani** (Visiting PhD Student), **Devashish Pandey** (Visiting Scientist), **David Barroso** (Internship student), **Lorena Sánchez** (Internship student), **Zanib Nadeem Aslam Tubassam** (Internship student), **Sara Navarro** (Travel Officer)

Happenings

ICFO NEWS

Nikon Center of Excellence for Experimental Super-Resolution at ICFO

As one of the main reference centers in Europe in the field of super-resolution, ICFO consolidates its involvement with **Nikon Europe B.V. and Izasa Scientific** (Nikon's official distributor in Spain), becoming a NIKON Center of Excellence for Experimental Super-Resolution.



ICFO first aligned with Nikon when they joined the Corporate Liaison Program (CLP), setting the stage for stable cooperation in super-resolution microscopy and advanced imaging techniques. Later in 2011, Nikon and ICFO partnered to open the Nikon Center of Excellence (NCoE) in STORM at ICFO. The recently signed new agreement reiterates the mutual willingness for continuous collaboration and broadens its scope, granting ICFO the label of Nikon Center of Excellence for Experimental Super-Resolution.

HFSP Research Grant

ICFO Prof. Dr. Michael Krieg, leader of the Neurophotonics and Mechanical Systems Biology research group, has recently been awarded a research grant from the Human Frontier Science Program (HFSP) for the project **"Intracellular selection and dynamics of mitochondrial ageing"**. The HFSP funding program is a highly competitive and prestigious award that supports innovative basic research into fundamental biological problems with emphasis placed on novel and interdisciplinary approaches that involve scientific exchanges across national and disciplinary boundaries. The project will involve an international team based at the UC Santa Barbara and LMU Munich.

"This grant will allow us to ... **determine how age affects mitochondrial health and vice versa**. Because of the highly competitive nature of this program/grant, it will also allow us to attract talented researchers to our group and help us to form collaborations with other international leaders in Europe and the US," explains Prof. Krieg.

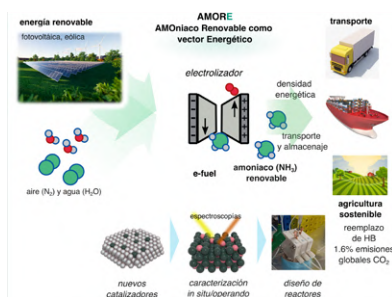


Postdoctoral Junior Leader "la Caixa" Fellowships

The "la Caixa" Foundation has announced the recipients of the **2023 "Incoming" call** for fellowships for their prestigious *Postdoctoral Junior Leader programme*. ICFO research fellow **Dr. Michela Picardi** in the **Thermal Photonics research group** led by Prof. Georgia Papadakis is one of the twenty-five researchers awarded in this call.

Dr Picardi came to ICFO in March 2022 from King's College where she carried out postdoctoral work on theoretical nanophotonics and light-matter interaction. She is currently working on radiative heat transfer for energy applications, within ICFO's Clean Planet Program.

The Ramón Areces Foundation finances new Clean Planet project at ICFO



ICFO Prof. Dr. F. Pelayo García de Arquer, leader of the CO₂ Mitigation Accelerated by Photons research group, has been awarded a grant from the Ramón Areces Foundation's XXI National Competition for the award of Grants for Research in Life and Material Sciences for the project **AMORE- Renewable Ammonium as an energy vector**. This project focuses on the **development of catalysts and systems that enable the direct electro-synthesis of green ammonia using air, water, and renewable electricity (eNRR)**, seeking to advance in the fundamental understanding of the processes involved in the eNRR. The CO₂ Mitigation Accelerated by Photons group will deploy in situ spectroscopies to guide in the design of nano/micro-structured catalysts that, based on metal and polymer composites, achieve improved the performance of the eNRR towards its techno-economic viability.

ICFO Distinguished Invited Professor

Prof. Claudia Felser, director of the Max Planck Institute for Chemical Physics of Solids, has been appointed ICFO Distinguished



Invited Professor (DIP). Through this position, she will participate in **research activities related to TWIST, a new macro-program at ICFO which has received funding from the Ministry of Science and innovation of Spain**. Within this ambitious research program, she, along with ICREA Prof. at ICFO Dr. Frank Koppens, and MIT Prof. and DIP at ICFO Dr. Pablo Jarillo-Herrero, will lead frontier research in twisted materials to study their fundamental properties and their potential future applications in nano-optoelectronics. A unique board of renowned scientists, including ICFOrians Prof. Dr. Adrian Bachtold and Dr. Carmen Rubio-Verdú, together with global leaders from Harvard, Stanford, Columbia, Princeton, Pisa and the Weizmann Institute, will also bring their expertise to the TWIST program.



ICFO Welcomes the Consellers of Economy & Finance and Research & Universities

On Tuesday, 13 June, the **Hble Ms. Natàlia Mas, Consellera of Economy and Finance of the Generalitat de Catalunya, together with Hble Mr. Joaquim Nadal, Conseller of Research and Universities** as well as the president of ICFO's Board of Trustees, visited ICFO, demonstrating their interest in the strategic research agenda of the institute.

The visit began with a meeting in which the Consellers were offered an executive summary of a few of the institute's research lines and relevant initiatives, such as projects related to the development of quantum technologies and photonic chips. They later toured the institute to learn more about these areas, pausing for a more in depth look at some of ICFO's technology transfer activities, including a presentation by ICFO spin-off company Quside Technologies.

The First Vice-President of the Government of Spain and Minister for the Economy and Digital Transformation visits ICFO

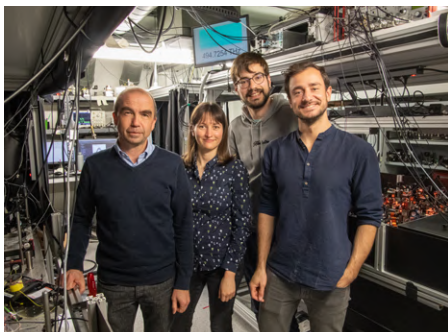


On May 18th, Vice President **Nadia Calviño**, accompanied by Mr. **Jaume Martorell**, Commissioner for the Spanish **PERTE Chip** (Strategic Project for Microelectronics and Semiconductors within the Spanish Plan for Recovery, Transformation and Resilience), visited ICFO to learn about some of the institute's key areas of expertise, including projects related to **quantum secure communication and quantum integrated photonic chips, quantum computation and simulation and the European Quantum Flagship Program**.

The entourage visited the laboratory that hosts QUIONE, the quantum computer-simulator that is being built at ICFO under Prof. Leticia Tarruell's leadership. She expressed great interest in economic impact and job creation based on research made at ICFO, also meeting with KTT director at ICFO Dr. Silvia Carrasco, as well as the CEOs of Quside and LuxQuanta, two growing ICFO spin-off companies.

Happenings

LATEST ADVANCES

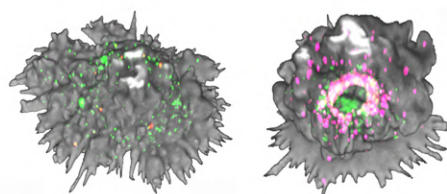


Long-distance quantum teleportation enabled by multiplexed quantum memories

In a recent study published in *Nature Communications*, ICFO researchers **Dario Lago-Rivera, Jelena V. Rakonjac, Samuele Grandi**, led by **ICREA Prof. at ICFO Dr. Hugues de Riedmatten** have reported achieving long distance teleportation of quantum information from a photon to a solid-state qubit, a photon stored in a multiplexed quantum memory. The technique involved the **use of an active feed-forward scheme, which, together with the multimodality of the memory, has allowed maximization of the teleportation rate.** The proposed architecture was compatible with the telecommunications channels, and thus **capable of enabling future integration and scalability for long-distance quantum communication.**

The experiment carried out by this group in 2021 in which they achieved for the first time entanglement of two multimode quantum memories separated by 10 meters and heralded by a photon at the telecommunication wavelength, was the precursor of this experiment. Prof. Riedmatten emphasized that **“quantum teleportation will be crucial for enabling high-quality long-distance communication for the future quantum internet.** Our goal is to implement quantum teleportation in more and more complex networks, with previously distributed entanglement. The solid-state and multiplexed nature of our quantum nodes as well as their compatibility with the telecom network make them a promising approach to deploy the technology over long distance in the installed fiber network”. Further improvements are already being planned.

New insights on the early stages of HIV infection in the human body



In a study published in *eLife*, ICFO researchers **Enric Gutiérrez, Nicolas Mateos, Kyra Borgman and Felix Campelo**, led by **ICREA Prof. at ICFO Dr. Maria García-Parajo**, in collaboration with researchers from the Germans Trias i Pujol Hospital and Research Institute, IrsiCaixa AIDS Research Institute, the University of the Basque Country and the University of Vic **use cutting-edge techniques like super-resolution microscopy and single particle tracking to study the spatial organization of Siglec-1 on dendritic cell membranes and its crucial role in the early stages of HIV infection.**

The team found that the **activation of dendritic cells leads to the formation of Siglec-1 nanoclusters**, which are instrumental in enhancing the capture of HIV-like particles. The binding of the virus via the nanoclustering of Siglec-1 triggers a massive and global transformation of the dendritic cells' actin cytoskeleton, which ultimately leads to the formation of a single sack-like compartment that accumulates the viruses. This **virus compartment has been implicated in the spreading and infection of the T-cells by the virus** leading to AIDS, but the mechanism behind its formation was until this finding, a mystery. These findings offer valuable insights into the complex interactions between the virus and the immune system.

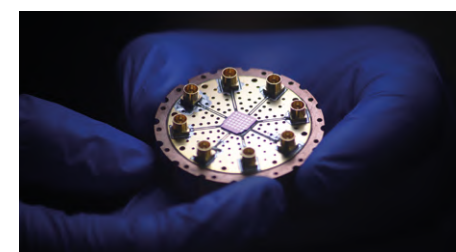
Super quick quantum random number generators enable “spooky action at a distance” between superconducting quantum bits



Random number generators, developed by **Quside Technologies** in collaboration with **ICREA Prof. at ICFO Dr. Morgan W. Mitchell**, **made possible a ground-breaking experiment**, published in *Nature*, conducted in the laboratories of Andreas Wallraff at ETH Zurich, in which they performed a **“loophole-free Bell test”**, similar to experiments that won the 2022 Nobel Prize in Physics. For the first time, the ETHZ experiment was able to perform this kind of experiment with superconducting quantum bits. In their experiment, they first “entangled” two superconducting qubits at temperatures near absolute zero and separated by 30 meters of distance. They then measured the state of the qubits simultaneously, and observed that the state of one qubit usually agreed with the state of the other qubit, a coordinated response consistent with “spooky action at a distance.” To be sure this coordination was not due to ordinary signals traveling from one qubit to the other, the ETHZ team chose randomly which type of measurements to make on the qubits, and they made the measurements so quickly that not even a signal at the speed of light could reach the other qubit in time. **Quside adapted their patented quantum random number generation technology, combining a novel parallel architecture with an extremely fast “randomness extraction” stage.** In this way, the QRNG devices delivered pure random bits in 17 nanoseconds. For the Quside/ICFO team, the participation in the ETHZ experiment is not just a chance to contribute to fundamental physics. **The experiment pushed the team to develop technologies that we now apply to communications security and high-performance computing, which also require fast, high-quality random numbers.**

First steps towards realizing mechanical qubits

In 2021, a group of international scientists including ICFO Prof. Dr. Adrian Bachtold established a solid theoretical concept of a mechanical qubit, based on a nanotube resonator coupled to a double-quantum dot under an ultra-strong coupling regime. These theoretical results proved that these nanomechanical resonators could indeed become ideal candidates for qubits because they were shown to feature long coherence times, a core requirement for quantum computing.



A recent study published in *Nature Physics* advances from this established theoretical framework. ICFO researchers **Chandan Samanta, Sergio Lucio de Bonis, Christoffer Moller, Roger Tormo-Queralt, W. Yang, and Carles Urgell**, led by **ICFO Prof. Dr. Adrian Bachtold**, in collaboration with researchers from the University of California Santa Barbara, Université Paris-Saclay-CNRS, Argonne National Laboratory, and Univ. Bordeaux-CNRS **achieved the first pre-experimental steps for the future realization of a mechanical qubit by demonstrating a new mechanism to boost the anharmonicity of a mechanical oscillator in its quantum regime**, contrary to what has been observed so far in other mechanical resonators. The results of this study set the first stepping stones for the future development of mechanical qubits or even quantum simulators.

Happenings

BUSINESS NEWS

2022 National Innovation Award

ICFO accepts award for the creation of LuxQuanta

ICFO's Director of Knowledge and Technology Transfer (KTT) **Dr. Silvia Carrasco**, ICREA Prof. at ICFO **Dr. Valerio Pruneri**, and LuxQuant CEO, **Vanesa Díaz** mounted the stage at the award ceremony organized by the Foundation for Research and Innovation of Catalonia (FCRi) and the Government of Catalonia to accept the **2022 National Innovation Award** for the creation of a science-based company, **LuxQuanta**.

In the ceremony that took place at the Teatre Nacional de Catalunya, the **President of the Generalitat de Catalunya, Pere Aragonès**, and the **Conseller for Research and Universities and Chair of ICFO's Board of Trustees, Joaquim Nadal**, presented ICFO with this award, along with the recipients of the National Research and awards in the categories of Scientific Patronage, Scientific Communication, and Public-Private partnerships.



LuxQuanta, ICFO's tenth spin-off company, was constituted in May 2021 after incubating in ICFO's KTT LaunchPad. The company works on the development and commercialization of quantum key distribution systems (QKD) for cryptography, which offer an additional layer of security for the communications of public and private entities. LuxQuanta's technology is based on the research carried out in the Optoelectronics group, led by ICREA Professor at ICFO Dr. Valerio Pruneri, a founding member of the company. Drs Sebastian Etcheverry (CTO) and Saeed Ghasemi (head of the Signal Processing Unit,) co-founders of LuxQuanta, helped develop prototypes of the technology during their time as postdoctoral researchers in the group.

ICFO continues to collaborate closely with LuxQuanta, notably in the European Quantum Communication Infrastructure (EuroQCI) Initiative as coordinators of national EuroQCI programs in Spain. Both are playing leading roles in national collaborations in designing and deploying a secure quantum communication infrastructure that will connect the cities of Barcelona and Madrid. All national programs around Europe will be executing the same tasks to achieve, in the long run, a secure quantum network spanning the whole EU, including its overseas territories.

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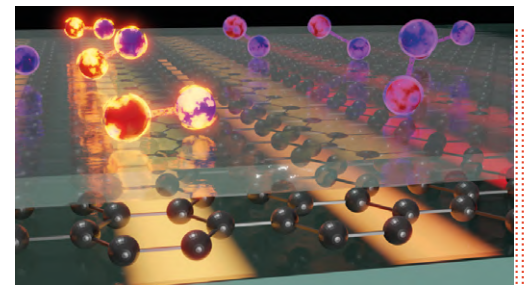
LuxQuanta is a spectacular example from within the group of companies that have spun-out of ICFO to date of what is possible in Catalonia: to create unique and competitive high technology / deep-tech projects on a global scale, to attract talent and also to attract investment.

Silvia Carrasco
KTT Director at ICFO

Proof of Concept Grant

ERC Funding to develop an optical (infrared) gas sensor demonstrator chip based on a novel graphene electro-polaritonic platform

The European Research Council, in its efforts to help ERC grant-holders to bridge the gap between their research and the earliest stage of a marketable innovation, created the Proof of Concept (PoC) funding scheme for researchers who have already been awarded an ERC grant. The grants are part of the EU's research and innovation program, Horizon Europe. Not only does this program help ERC grantees to bridge the gap between the results of their pioneering research and the early phases of its commercialization, the program complements the efforts of ICFO's Knowledge and Technology Transfer Unit (KTT), which proactively searches for ways to translate newly generated knowledge into new technologies.



ICREA Prof. at ICFO Dr. Frank Koppens, leader of the Quantum Nano-Optoelectronics research group, has been awarded his **fifth PoC to date**, the fourteenth award of this kind for ICFO in the past ten years, for the project titled **POLARSENSE**. This project aims to develop an optical (infrared) gas sensor demonstrator chip based on a novel graphene electro-polaritonic platform.

Quside's Quantum Technology Showcase

Event addressing trends and challenges in the transition to quantum resistant cryptography and hardware acceleration of complex computations

In an event for partners, Quside hosted more than 40 companies and 15 speakers of leading companies in the industry. During the event Quside presented its new brand and new products for quantum random number generation (QRNG) and announced the availability of its Randomness Processing Unit (RPU) on Amazon Web Services.



 **Quside**

Collaboration

BUSINESS NEWS

Corporate Liaison Program Day: Quantum Networks

Co-located with the first meeting of the Quantum Flagship's QSN Partnership, ICFO held its **annual CLP Day to focus on Quantum Networks**. ICFOians, representatives of international platforms, multinational corporations, local business representatives and researchers of other institutions have the opportunity to interact with experts from around the world in a particular sector to review the latest advances in photonic technologies while focusing on the generation of joint research projects.



Agenda Highlights

- **Quantum Communications in EU:** Gustav Kalbe, Acting Director of Digital Excellence and Scientific Infrastructures, European Commission
- **European Quantum Communications Infrastructure (EUROQCI):** Johanna Sepúlveda, Airbus
- **European Quantum Communications Infrastructure (EUROQCI):** Elani Diamanti (CRNS), Romain Alléaume (Telecom Paris), Antonio Pastor Perales (Telefonica I+D), with an overview by Valerio Pruneri (ICFO, QSNP coordinator)
- **SGA: Quantum Internet Alliance:** Hugues de Riedmatten (ICFO) and Stephan Ritter (Toptica)
- **Quantum Investors Panel:** Olivier Tonneau (Quantonation), Stuart Nicol (Quantum Exponential) and Flavia Tomarchio (Constructor Capita)

RESEARCH NETWORKS

Quantum Secure Networks Partnership Kick-off

Consortium partners of this Quantum Flagship project came together at ICFO



Digital communications have been a key component of all of society's connectivity advances

over the last decades and today there is an increasingly urgent need to protect sensitive information that travels over these networks. Many existing cryptography techniques that are used to secure our information are in fact based on methods that are becoming vulnerable to the constant increase of computer processing capabilities.

Coordinated by ICREA Prof. at ICFO Dr. Valerio Pruneri, the Quantum Secure Networks Partnership (QSNP), a new project launched in March 2023 in the area of quantum communications of the Quantum Flagship, brings together more than 40 partners from all over Europe, ranging from academia, foundries and RTOs, SMEs and spin-offs, to network and cryptography integrators and telecom operators. In the time span of 3.5 years and with a budget of 25M€, these experts in the field of quantum technologies will seek to fulfil three main goals.

1) Develop and deploy next generation protocols based on Quantum Key Distribution (QKD) cryptography techniques, that can help reduce the security assumptions needed for the networks, extend the range of secure communication, and search for new functionalities that could be beyond these techniques.

2) Integrate this innovative quantum cryptography technology not only at the component, system and network levels, but also into existing classical telecommunication systems and post-quantum protocols, assuring an additional layer of ultra-secure communications in this hybrid classical-quantum network.

“

We are thrilled to commence this innovative program. With QSNP, we are now moving out into the terrain where we will be able to develop further and most of all test the research development carried out in the first phase of the flagship. With the +40 entities within this gran consortium, we expect to achieve unprecedented performances and new designs for application-specific cryptography, covering the full chain from quantum fundamental to product development.

Prof. Valerio Pruneri
Leader of the Optoelectronics group at ICFO
and coordinator of QSNP

3) Apply all the know-how and capabilities acquired, as well as the technology developed, into different use cases, mainly into delivering critical European technology for government infrastructures such as the European Quantum Communications Infrastructure (EuroQCI). In doing so, they are interested in identifying the potential users, be it authentication, long-term secure storage, critical infrastructure protection, clock synchronization or primitives beyond QKD, in order to provide robust and solutions to their needs.

In addition, the project will be a launchpad for future applications, to exploit new capabilities, evaluate new cost/effective features, measure use/integration easiness levels, and explore new sectors where quantum technologies could take over markets that are not being reached by the current technology.

2nd Annual Meeting of the Barcelona Medical Photonics Network

Gathering of experts focuses discussion on microcirculation in health and disease

The **Barcelona Medical Photonics Network (BMPN)** met at Parc Taulí Hospital for its annual meeting. The BMPN formally launched in March 2021 as a platform to promote the research and development

activities in photonics being carried out in the Barcelona region through long-standing collaborations between ICFO and its biomedical and clinical partners. This year, **discussions focused on microcirculation in various fields, including critical care, cancer, stroke, and infant development**, with contributed talks from experts within the network and from European collaborators. Outcomes of two international collaborations led by ICFO (HEMOCOV-19 and VASCOVID) were also presented. **ICREA Prof. at ICFO Dr. Turgut Durduran**, leader of the Medical Optics research group, introduced the event,



highlighting the collaborative nature of the network and the shared goal of all present to work toward increased integration of photonics solutions in a variety of medical techniques and practices.

Collaboration

TRAINING

The Young Atom Opticians Conference 2023

June 11-16th ICFO was pleased to open its doors to PhD students from around the world for the 28th edition of YAO

This well-established international meeting is organized annually by PhD students. Since the first edition in 1995 which was planned and executed by Innsbruck University, YAO has taken place at different scientific institutions around Europe, including the 19th edition of the program that took place at ICFO. It is now the largest student conference in the field of atomic and molecular optics.

The Planning process for ICFO's hosting of YAO 2023 began at the 2021 conference organized by Aarhus University. **ICFO Planning Committee Members Natalia Alves, Javier Argüello Luengo, Sven Bodenstedt, Sandra Buob, Daniel Goncalvez Romeu, Lukas Heller, Jonatan Höschele, Tomáš Lamich, Jan Lowinski, and Laura Zarraoa Sardón** pulled together to create a high impact scientific conference tailor made for PhD students who attend because they are motivated to learn from and build community with participants from institutes from around the world.

The main goal of the YAO conference is to **strengthen scientific exchange among young students in the field in order to create a strong international community**. It aims to offer an optimal platform for participants to obtain a broad overview of the state-of-the-art research, to expand their network and establish new contacts around the world. For many students, it represents the first opportunity to show their own results and discuss them with peers.



Invited Speakers:

- **Daniel Barredo**, CINN – CSIC & Institut d'Optique – CNRS
- **Darrick Chang**, ICFO, Barcelona
- **Francesca Ferlino**, IQOQI, Innsbruck
- **Svenja Knappe**, University of Colorado, Boulder
- **Juliette Simonet**, Universität Hamburg
- **Lukáš Slodička**, Palacký University Olomouc

Simón Perera, General Secretary of PRISMA "LGBTI+ Science" helped bring PRIDE to YAO by offering an invited talk entitled "10 measures to improve LGBTIQA+ reality in STEM centers"



116 PhDs

participated in YAO 2023

Participants came from

69 Institutes

Located in

17 Different countries

 **+INFO** www.yao2023.icfo.eu



“

The YAO Conference means a lot to me because it was my first chance to present my work back in 2019 when I attended a great event organized in Hamburg. I learned so much at that conference- and those that followed- that I was really motivated to be involved in organization as a way of keeping this great community event going for future generations.

Lukas Heller

Quantum Photonics with Solids and Atoms group

It was nice to see people I met at Stuttgart last year who came to Barcelona. As organizers, this was our chance to show our institute, our city and share our PhD experience with the participants.

Tomáš Lamich

Atomic Quantum Optics group

Organizing a conference like this is gratifying but also a lot of work. No one knows this (now) more than Jan and Lukas who did more than anyone else to make this a success.

Laura Zarraoa

Atomic Quantum Optics group

2024 YAO Strasburg and 2025 YAO Innsbruck, here I come!

Atomite

The Sloth- Conference Mascot

ICFO-IMPRS Joint Workshop

April 19-21 ICFO hosted the 3rd student organized event

This bi-annual event brings together PhD students from ICFO and the International Max Planck Research School for Quantum Science and Technology (IMPRS) for three packed days of scientific discussion and networking.

The program, which was **organized by PhD students from both institutions**, included invited talks, poster sessions, and PhD presentations, as well as an industry session, and fun social activities. All participants were encouraged to present their research work in poster sessions and student talks.



$$\frac{1}{\sqrt{2}} \left(\left[\text{ICFO} \right] + \left[\text{IMPRS} \right] \right)$$

ICFO  **IMPRS**
for Quantum Science and Technology
INTERNATIONAL MAX PLANCK RESEARCH SCHOOL

Invited Speakers:

- **Thomas Weitz**: Georg-August-Universität Göttingen, Quantum transport in 2D materials group
- **Frank Koppens**: ICFO, Quantum Nano-Optoelectronics group
- **Antonio Acín**: ICFO, Quantum Information Theory group
- **Ana Belén Sainz**: ICTQT - Gdansk University, Quantum Foundations group
- **Jordi Tura**: Leiden University, Applied Quantum Algorithms group
- **Leticia Tarruell**: ICFO, Ultracold Quantum Gases group
- **Jan von Delft**: LMU, Theoretical Solid State Physics group
- **Morgan Mitchell**: ICFO, Atomic Quantum Optics group
- **Johannes Zeiher**: MPQ, Quantum Many Body Systems group

Student Organizers:

Fionnuala Curran (ICFO), **Teresa Karanikolaou** (ICFO), **Benjamin Schiffer** (IMPRS), **Daniel Goncalves** (ICFO), **Bennet Windt** (IMPRS), **Maria Balanzó-Juandó** (ICFO), **Johannes Halbinger** (IMPRS)

Collaboration

MUSIC & SCIENCE

Quantum Sounds Symposium

A gathering of a growing community of artists, scientists and enthusiasts interested in exploring the interplay between music, randomness, sound, and quantum physics

This unique three-day event which took place at **ICFO** (day 1 and 2) and **La Salle-Ramon Llull University** (day 3) was organized by **Dr. Reiko Yamada**, ICFO postdoctoral researcher and **ICREA Prof. at ICFO Dr. Maciej Lewenstein**, leader of the Quantum Optics Theory Group, as the culmination of the interdisciplinary research project, "Interpreting Quantum Randomness" which aimed to unite quantum randomness and music. The collaboration of **Dr. Osvaldo Jiménez Fariñas**, La Salle- URL and **Dr. Jose Manuel Berenguer**, Universitat de Barcelona, La Orquestra del Caos brought important musical perspectives and collaborations to the program which featured several lectures around the topic of **sound and music creation with superconducting systems, data sonification, interactive sound interface, sound programming and audio software development.**

Attendees had the opportunity to expand their knowledge and inspiration through some of the most recent research done on the junction of quantum physics and music composition.



“

I think it was very fun to have live musicians come to ICFO, a Physics institute, to this auditorium where usually only scientific presentations take place, to have a performance of extremely experimental music, and to have an audience really appreciate the performance.

I think it was very special.

Dr. Reiko Yamada

ICFO postdoctoral researcher

In the opening session, "Tensorial Ripples" by Eduardo Reck Miranda, Paulo Itaboraí and Cephas Teom, researchers at the University of Plymouth, presenters showcased three examples **leveraging quantum mechanical phenomena** such as entanglement, interference and superposition to compose music. Some of the other highlights include the lecture-concert "Interpreting Quantum Randomness, Studies on Wigner Function" featuring the Flying Trees String Quartet or the closing session by IBM researchers James Weaver and Brian Ingmanson "Hilbert Space Deep House", a **live demonstration on electronic music composition with quantum states.**

Participants also had the opportunity to participate in **panel discussion between quantum physicists, musicians, and members of the growing quantum technologies industry**, to discuss the new and varied frontiers harnessing quantum phenomena.



Eduardo Reck Miranda, Paulo Itaboraí and Cephas Teom

The final day took place at La Salle-Ramon Llull University and focused on **exploring the interrelation of quantum science and art with two round-table debates.** Attendees also visited the anechoic and reverberant chambers and participated in the sound performance "Resonant Spaces". The symposium culminated in a closure event celebrated in Hangar.org, which featured the joint lecture "Looped in the Sound of Photon" by composer and performer Ángel Faraldo and Qside CEO Carlos Abellán. Finally, several guest speakers in the symposium took part in an **improvisation concert** organized by Reiko Yamada and Jose Manuel Berenguer to build an unprecedented musical experience, by generating unpredictable and truly random numbers in real-time using a Qside quantum random number generator.



▶ **LINK TO VIDEO**

<https://youtu.be/314AF4JZfVc>

OUTREACH



Be an ICFOian for a Day: The Final Event

On the 22nd of June, ICFO hosted the closing event of *Be an ICFOian for a Day*, a program aimed at women* students in undergraduate and master STEM programs.

Twenty-six women participated enthusiastically in this first edition, taking full advantage of the opportunity to experience ICFO through networking events, a one-day visit to an ICFO research group, insights into new career opportunities, and a valuable negotiation training session.

During the final group event, students were able to attend the "Photonics is Everywhere" CARLA capsule, a panel featuring photonics experts from academia, industry, and beyond. This provided valuable knowledge and brought on rich discussions during the networking session. The positive feedback from the students demonstrated their appreciation for the event's content and organization.

Participants gave very positive feedback on the entire program, rating it 4.7/5 in follow-up questionnaires.



The activity that lends its name to the program, in which students were embedded in one of ICFO's research groups for one day, was exceptionally well rated. Likewise, students found the the opportunity to talk to women in ICFO research groups and to build and grow their network particularly enriching.

Building on this success, the second edition of the program has recently been announced, continuing this fruitful project to offer new students the opportunity to delve deeper into the fascinating world of photonics.

* An inclusive event for all women, including cis and trans women, genderqueer, and non-binary people

Collaboration

OUTREACH

Quantum CARLA

The Quantum Careers Symposium Barcelona

The 2nd edition took place on 26th April and streamed live on the ICFO YouTube channel

This event, organised by the Quantum Flagship and the Master in Quantum Science and Technology Barcelona, in collaboration with the EU projects DigiQ and QTIndu, brought together 25 speakers from many of the exciting professional areas in the field Quantum Technologies with the ultimate goal to attract talent to the field. Participating companies included Airbus, LuxQuanta, Pasqal, Nestle, Quside and Qilimanjaro.



The symposium fostered a diverse and inclusive environment, with speakers coming from academic backgrounds, industry, and start-up companies. Participants also had the opportunity to explore various career opportunities, initiatives in photonics, and entrepreneurship. In addition to the inspiring talks and panels around academic and industry career paths, large quantum European initiatives such as QSNP, QIA, OPMMEG and EuroHPC gave overall introductions showing the audience the vast range of research and development initiatives that Europe is carrying out in quantum technologies. All the sessions gave a glimpse of the many career paths and job opportunities available in the field of quantum technologies, which are currently facing a high demand in recruiting for different profiles.

Participants also had the opportunity to meet and network with the representatives of the companies, research institutions and projects. This symposium was focused on giving students an introduction to the field of quantum technologies and possible competencies they will need in case they wish to fulfil their professional path in this field.



COMMUNITY

ICFO Ambassador in India

ICFO alumnus Prof. Dr. Chaitanya Kumar Suddapalli inaugurates a program that will act as a bridge between ICFO and scientific stakeholders in India

Prof. Dr. Chaitanya Kumar Suddapalli, PhD graduate and later postdoctoral researcher in the Optical Parametric Oscillators group led by ICREA Prof. Dr. Majid Ebrahim-Zadeh, has recently been appointed as the ICFO Ambassador in India. Chaitanya returned to his native India after more than 14 years, having served in various academic as well as industrial positions. He is currently a Reader at the Tata Institute of Fundamental Research (TIFR), Hyderabad.



“

I have longstanding and deep-rooted ties with ICFO, as a PhD graduate, collaborator with the Knowledge and Technology Transfer unit and also as a Research Fellow. I am highly motivated to build the foundation for sustained collaboration by strengthening my ties with ICFO from my home country.

**Prof. Dr. Chaitanya
Kumar Suddapalli**

“

ICFO is fortunate to be able to count on Chaitanya's support, advice and insights to help orient our institute on opportunities to engage with scientific collaborators and stakeholders in India. This is a great opportunity for ICFO to team-up with the country's extremely talented scientific community.

Lluís Torner
ICFO Director

He has long maintained constructive institutional ties with ICFO as a member of the Alumni Network and continued collaborator. At the same time, he has nurtured strong relations with ICFOnians in India and shown an active interest in increasing the visibility of ICFO's research impact in the country.

Now operating in the official capacity as an Alumni Ambassador, the first such program to be launched by ICFO abroad, Chaitanya will work to unite and strengthen ICFO's Indian Alumni network, and also to coordinate, organize and promote ICFO events such as schools, workshops and career camps at TIFR and other Indian institutions.

Alumni at CLEO

The Alumni Network organizes gatherings to give members of the community the opportunity to network, catch-up on news of jobs, and projects, and to build a strong network that will be a supporting structure over the course of careers in academia, industry and beyond.

Keep an eye on Alumni event and plan to participate to reconnect with friends and colleagues.



“

It is only now after three years working at ICFO and finally attending this event that I have been able to see that more than networking events, these gatherings are truly reunions of friends who have shared either months or years of memories and experiences

Andrea Morales
ICFO Communities Coordinator

People

GO & FLY

Congratulations to 11 New ICFO PhD Graduates

294 ICFOnians have successfully defended their theses

Each of these ICFOnians has played an important role in ICFO's success and reputation as a leading international research institute. Honoring ICFO's tradition, ICFOnians celebrate this important personal, professional and institutional milestone and encourage you to Go & Fly! Remember that wherever you go, you will always be a part of the ICFO community.



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Valerio di Giulio
Nanophotonics with charged particles

📅 April 12, 2023
ICREA Prof. Dr. Javier García de Abajo



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Robin Camphausen
Quantum-enhanced imaging with SPAD array cameras

📅 April 12, 2023
ICREA Prof. Dr. Valerio Pruneri



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Unai Ortiz de Orruño Cuesta
Optical holographic microscopy for bio- and nanoparticle characterization

📅 April 21, 2023
ICREA Prof. Dr. Niek van Hulst



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Arturo Villegas Juárez
Optical parameter sensing: sensitivity limits and the advantages of using spatial modes of light

📅 April 26, 2023
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📅 April 28, 2023
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Advanced single molecule fluorescent tools to reveal spatiotemporal multi-molecular interactions in living cells

📅 April 28, 2023
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📅 May 24, 2023
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Natalia Domingues Alves
Single-atom motional dynamics in an optical dipole trap

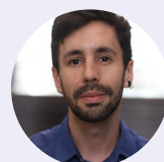
📅 June 16, 2023
ICREA Prof. Dr. Morgan Mitchell



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Craig Chisholm
Raman dressed Bose-Einstein condensates with tunable interactions: topological gauge theories and supersolids

📅 June 19, 2023
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Daniel Martínez Cercós
Highly percolate ultra-thin metals films for reconfigurable metasurfaces

📅 June 21, 2023
ICREA Prof. Dr. Valerio Pruneri and Dr. Bruno Paulillo



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Jelena Rakonjac
Light-matter entanglement between telecom photons and solid-state quantum memories

📅 June 26, 2023
ICREA Prof. Dr. Hugues de Riedmatten

COMMUNITY PICTURES

1. Annual Beach Volley Charity Tournament
2. Enthusiasts-CGT, ICONS and the Diversity & Inclusion Committee organized activities to celebrate PRIDE at ICFO, showing support for all members of the LGBTQIA+ community
3. World Safety & Health at Work Day at ICFO
4. The annual celebration of Sant Jordi at ICFO



Mystery ICFOnian

How much do you know about the people you work with?

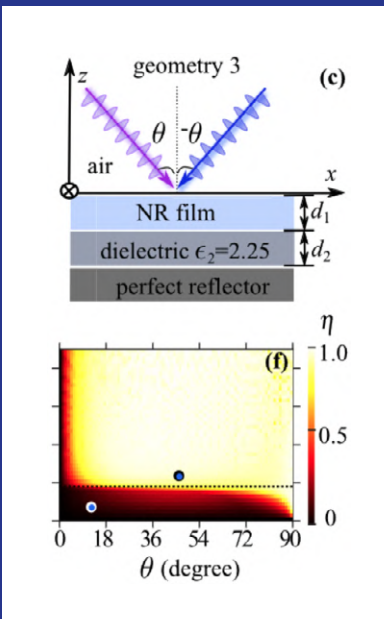
ICFOnians are a fascinating group, with hobbies, interests and talents that may surprise you. Have a look around and see if you can guess who this edition's Mystery ICFOnian is!

Look for the answer in the next edition of ICFOnians.

1. He is an ICFO Biker.
2. As a hobby he enjoys producing electronic music and has even started working with record companies.
3. He started working at ICFO in 2018 and since then has come to know the name and face of almost all ICFOnians.
4. He was a dedicated gymnast, first as a member of the Spanish National Artistic Gymnastics team and then as a competitive trampolinist.
5. Having survived and recovered completely from a near fatal spinal injury, he feels as though he has been "reborn".

The Last Word

SCIENCE QUIZ



ICFO researchers Lu Wang, F. Javier García de Abajo and Georgia T. Papadakis recently published “Maximal violation of Kirchhoff’s law in planar heterostructures” in *Physical Review Research*, showing that simple, planar geometries can be used to evade Kirchhoff’s law using Weyl semimetals.

1. Gustav Robert Kirchhoff discovered laws of nature about what topic?

- A) Thermal radiation
- B) Electronic circuits
- C) Chemical reactions
- D) All of the above

2. What does Kirchhoff’s law of radiation say?

- A) Etendue is non-decreasing
- B) Index \times phase velocity is conserved
- C) Emissivity = absorptivity

3. What property of a Weyl semimetal allows it to evade Kirchhoff’s law?

- A) A Dirac-equation like dispersion relation
- B) Time-reversal symmetry breaking
- C) Topological band structure

4. Which of the following solar-energy concepts did not come from particle-physics?

- A) Weyl fermions
- B) Axion electrodynamics
- C) Method of strings

HIGH PROFILE

Oscar Pallarols

Chief Commercial Officer, Cellnex Telecom

What is Cellnex’s vision about innovation in general?

We think about innovation by analyzing what can have a relevant impact on our business, and in what areas this impact may take place in a three-year horizon and beyond. For Cellnex it is absolutely key to be able to anticipate which vectors will be decisive in infrastructure management and which may be our key assets in a few years. This requires a team dedicated to innovation in three aspects that support our model.

The first refers to **technological evolution**, which, because it is so fast in our sector, requires permanent attention. For example, just a few years ago, with the implementation of 4G technology, the key to competitive advantage was well-located towers. The launch of 5G established a totally different scheme, with installations almost at street level. Had we not anticipated this, we would have stayed on the rooftops and lost the opportunity for urban furniture as a communication point.

Our second priority innovation vector has to do with the **business model**. A few years ago, no one would have foreseen that the tower would cease to be a strategic asset for mobile operators. The commoditization, monetization and sharing of the towers among competitors has created a different competition framework that was key in the conception of our business.

Related to this, our third relevant derivative has to do with the **search for new opportunities**. For example, under the concept of “augmented towerco” we are evolving the core of our business, the towers, towards systems in which other types of services can be shared with the pooling of active network elements and scalable solutions that are better managed by a neutral operator.

What has motivated Cellnex to participate in European innovation projects related to Quantum Technologies?

The evolution of our business model beyond the towers forces us to understand the additional layers of services complementary to the transmission of data and information for which there may be a future demand closely linked to the digital infrastructure. Our towers, for example, are already being equipped with fiber and *edge computing* facilities to become processing points that make it possible to protect the operators’ network, an aspiration in which quantum technology will play a decisive role. Quantum communication allows us to increase the security and reliability of communication lines, generating a new gap in the face of computer intrusion threats.

We recently participated in the first connection with quantum cryptography with our own technology in what we consider to be the embryo of what could be the future metropolitan network in Barcelona and the planned pan-European quantum communications infrastructure (EuroQCI), in an initiative promoted by ICFO.



“

Quantum communication allows us to increase the security and reliability of communication lines

We need to understand the technology and the ecosystem and test it in the context of our business. There is a small constellation of European projects in which we participate and whose objective is to progress in the definition of technology, architecture, how it would be used as a service, what are the use cases and the identification of the first demand sectors that could contract these services.

How would you rank cybersecurity in the list of challenges facing telecommunications companies?

This is an absolute priority area. The security element has always been a major concern, but it has accelerated exponentially due to the enormous volume of digitized information that is only transmitted over networks. Technological advancement in computing and AI allow system breaches to take place faster and with less effort. This is a key area where we must widen the gap between the computer skills of hackers and the protection of companies, institutions or individuals through quantum technology.

How do you foresee the future in terms of connectivity and security?

Inevitably, just as the capacity of the system increases, so do the risks. The greater the technological integration, the greater the performance, but also the greater danger of a failure being transmitted to the whole. And it is at this point that we must ensure that all the layers of protection eliminate vulnerabilities through real-time monitoring allowing margin to react. This is where quantum technology will be an essential tool.

As a telecom engineers, what do you find most rewarding about working in this industry?

The speed of change is so dizzying that it maintains a permanent positive tension. It is a sector that forces you to be permanently at the forefront of new technologies, giving you the perception of being a tireless explorer. The result of inroads we make today will affect all those who come in the future. That being said, honestly, there are times when a more relaxed dynamic would be appreciated, if only for a few days.

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